

Shizhou Xu

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Research Interests

- **Mathematics:** Probability theory, optimal transport, dynamical systems, ergodic theory, mathematics of data science, mathematical foundations of machine learning.
- **Statistics:** Mathematical statistics, high-dimensional statistics, causal inference, uncertainty quantification.
- **Machine Learning:** Learning theory, fairness, privacy, robustness, generalizability, explainable AI, AI4Science, physics-informed machine learning, generative AI, multi-modal learning, and machine unlearning.

Education

2021-2024	PhD in Applied Mathematics	University of California, Davis (UC Davis)
	• Dissertation: <i>Fairness in Machine Learning via Optimal Transport</i> • Advisor: Prof. Thomas Strohmer • Key Achievements: Solved three open problems in machine learning fairness, as listed by NeurIPS 2022, using optimal transport theory.	
2016-2018	MSc in Mathematics	New York University (NYU)
2013-2016	BA in Mathematics, BA in Economics	Emory University
	Dean's List (2013-2016)	

Academic Appointments

2024-Pres.	Postdoctoral Scholar	UC Davis
	Advisor: Prof. Thomas Strohmer; Co-PI on NSF Award (2027248); developing a mathematical framework for synthetic data generation.	
2025	Instructor, MATH 127C (Real Analysis), Summer Session	UC Davis
	Designed syllabus and assessments; delivered full course instruction.	
2022-2024	Graduate Student Researcher	UC Davis
	Contributed to the NSF TRIPODS project on <i>Mathematics of Data Science</i> .	
2021-2023	Teaching Assistant	UC Davis
	Courses: Vector Analysis, Linear Algebra, Calculus.	

2022	Visiting Member	IPAM, UCLA
	Participated in IPAM Long Program; contributed to the AI for Science workshop.	
2019–2021	Graduate Research Assistant	NYU
	Research on stochastic dynamical systems, optimal transport.	

Publications

JOURNAL ARTICLES

2025	Shizhou Xu. <i>Utility–Separation Pareto Frontier: An Information-Theoretic Characterization</i> , under review at Journal of Machine Learning Research (JMLR), available on request.
2025	Shizhou Xu , Yuan Ni, Stefan Broecker, Thomas Strohmer. <i>Forgetting-MaRI: LLM Unlearning via Marginal Information Regularization</i> , under review at ICLR 2026, a patent application is pending, available on request.
2025	Y. Ni, Z. Chen, S. Xu , C. Peng, R. Plumley, C. H. Yoon, J. Thayer, and J. Turner. <i>Multi-resolution Enhancement for Full Spectrum Neural Representations</i> , under review at Nature Machine Intelligence, 2025, available on request.
2025	Shizhou Xu , Thomas Strohmer. <i>Machine Unlearning via Information Theoretic Regularization</i> , available on request.
2024	Shizhou Xu , Thomas Strohmer. <i>WHOMP: Improving Upon Randomized Controlled Trials via Wasserstein Homogeneity</i> , under review at Journal of the American Statistical Association.
2024	Shizhou Xu , Thomas Strohmer. <i>On the (In)Compatibility between Individual and Group Fairness</i> , under review at SIAM Journal on Mathematics of Data Science (SIMODS).
2023	Shizhou Xu , Thomas Strohmer. <i>Fair Data Representation for Machine Learning at the Pareto Frontier</i> , Journal of Machine Learning Research (JMLR), 24 (2023), 1-63.

MANUSCRIPTS IN PREPARATION

2025	Shizhou Xu , Thomas Strohmer. <i>Langevin Dynamics with Wasserstein Energy</i> , in preparation.
2025	Shizhou Xu , Yuan Ni, Stefan Broecker, Thomas Strohmer. <i>Multi-Modal Embedding for Machine Learning</i> , in preparation.

Industry Impact

2025	<i>Fair Data Representation for Machine Learning at the Pareto Frontier</i> was recommended as guidance on fairness-mitigation techniques for ML-based financial transactions in the Alan Turing Institute’s official report, produced in collaboration with Mastercard.
2024	The <i>WHOMP</i> method and its implemented Python package were adopted by Quantum Leap Healthcare Collaborative (QLHC) to minimize accidental bias in a clinical trial involving 2,000 cancer patients, aimed at defining a new concept of ‘minimal residual disease,’ just two weeks after publication.

Conference Presentations & Invited Talks

2026	<i>Machine Unlearning via Information Theoretic Regularization</i> , AIM (American Institute of Mathematics) Workshop on "Fairness and Foundations in Machine Learning" (to appear).
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2026	<i>Machine Unlearning via Information Theoretic Regularization</i> , Joint Mathematics Meetings (to appear).
2025	<i>Machine Unlearning via Information Theoretic Regularization</i> , Applied Math Seminar @ University of Utah.
2025	<i>Machine Unlearning via Information Theoretic Regularization</i> , INFORMS Annual Meeting.
2025	<i>Machine Unlearning for Scientific Discovery</i> , SLAC Users Meeting @ Stanford University.
2025	<i>WHOMP: Improving Upon Randomized Controlled Trials via Wasserstein Homogeneity</i> , International Conference on Learning Representations, Workshop (ICLR).
2025	<i>WHOMP: Improving Upon Randomized Controlled Trials via Wasserstein Homogeneity</i> , Conference on Parsimony and Learning (CPAL), Spotlight Track.
2025	<i>WHOMP: Improving Upon Randomized Controlled Trials via Wasserstein Homogeneity</i> , Math of Data & Decisions @ UC Davis Seminar (MADDD).
2024	<i>Fair Data Representation for Machine Learning at the Pareto Frontier</i> , Computational Harmonic Analysis in Data Science and Machine Learning, Casa Matemática Oaxaca & Banff International Research Station (CMO-BIRS).
2024	<i>Fair Data Representation for Machine Learning at the Pareto Frontier</i> , International Conference on Machine Learning (ICML).
2023	<i>Fair Data Representation for Machine Learning at the Pareto Frontier</i> , Explainable AI for the Sciences Workshop, Institute for Pure & Applied Mathematics (IPAM), University of California Los Angeles (UCLA).
2022	<i>Fair Data Representation for Machine Learning</i> , SIAM Conference on Mathematics of Data Science (MDS).
2022	<i>Fairness in Machine Learning</i> , Inclusivity, Equity, and Ethics in Research and Data Science, UC Davis.

Teaching Experience

2025	Instructor, <i>MATH127C: Real Analysis</i> , Summer Session	UC Davis
2022	Teaching Assistant, <i>Vector Analysis</i> , Winter Quarter	UC Davis
2022	Teaching Assistant, <i>Vector Analysis</i> , Fall Quarter	UC Davis
2022	Teaching Assistant, <i>Linear Algebra</i> , Summer Session	UC Davis
2022	Teaching Assistant, <i>Calculus I</i> , Spring Quarter	UC Davis
2021	Teaching Assistant, <i>Vector Analysis</i> , Winter Quarter	UC Davis
2019	Recitation Leader, <i>Mathematics for Economics II</i> , Spring Semester	NYU
2017	Recitation Leader, <i>Mathematics for Economics II</i> , Fall Semester	NYU
2017	Recitation Leader, <i>Mathematics for Economics I</i> , Spring Semester	NYU

Awards and Honors

2024	Yueh-Jing Lin Scholarship	UC Davis
2023-2024	Co-PI of NSF Award 2027248	UC Davis
2022-2024	Supported by NSF TRIPODS Grant	UC Davis
2022	Long Program Fellowship	IPAM, UCLA
2021-2022	Mathematics Department Fellowship	UC Davis
2019-2021	School of Engineering Scholarship	NYU
2013-2016	Emory Dean's List	Emory

Service and Professional Activities

JOURNAL REVIEWER

Present *Physical Review X*
Present *SIAM Journal on Mathematics of Data Science*
Present *Journal of the European Optical Society*

CONFERENCE REVIEWER

2024–2025 *NeurIPS* (Neural Information Processing Systems)

SEMINAR (CO-)ORGANIZER

2024–2025 *Mathematics of Data and Decisions Seminar (MADDD)*, University of California, Davis

WORKSHOP CHAIR

2022 *Machine Learning Session I*, SIAM Conference on Mathematics of Data Science (MDS)

Industry Experience

2023 Summer Associate (Quantitative Strategy) Goldman Sachs

Technical Skills

- Programming Languages: Python, MATLAB, $\text{\LaTeX}$
- Libraries/Frameworks: PyTorch, Scikit-learn, NumPy, SciPy, Pandas, Matplotlib